WHAT IS CLAIMED IS:

1. A stress measurement method using X-ray diffraction, comprising the steps of:

(a) preparing a c-axis-oriented specimen of a tetragonal polycrystal as a specimen to be measured;

(b) defining, as a specimen coordinate system, a coordinate axis P3 perpendicular to a surface of the specimen and two coordinate axes P1 and P2 orthogonal to each other within the specimen surface, and arranging an X-ray optical system including an X-ray source and an X-ray detector within a plane including the coordinate axes P1 and P3;

(c) selecting one set of Miller indices (hkl) of the specimen, and arranging the X-ray source and the X-ray detector to be symmetrical with a normal to a crystal plane with said one set of Miller indices (hkl), the normal to the crystal plane being inclined from a normal to the specimen surface at an angle of ψ, so that a diffracted X-ray from the crystal plane with said one set of Miller indices (hkl) can be detected with a diffraction angle θ_0 (diffraction angle in a non-strain state);

(d) irradiating the specimen with an X-ray, detecting the diffracted X-ray therefrom with the X-ray detector, adjusting the X-ray optical system to find out the

diffraction angle θ at which the diffracted X-ray exhibits a maximum intensity, and determining the diffraction angle θ as a measurement value;

(e) determining a strain through the use of the diffraction angle θ_0 in the non-strain state and the diffraction angle θ measured;

(f) selecting another set of Miller indices (hkl) of the specimen, repeating the above-described steps (c) to (e), and determining a strain with respect to said another set of Miller indices (hkl);

(g) arranging the X-ray optical system including the X-ray source and the X-ray detector within a plane which is derived by rotation of the plane including the coordinate axes P1 and P3 around the coordinate axis P3 through an angle of $\phi = 45°$;

(h) repeating the above-described steps (c) to (f);

(i) arranging the X-ray optical system including the X-ray source and the X-ray detector within a plane which is derived by rotation of the plane including the coordinate axes P1 and P3 around the coordinate axis P3 through an angle of $\phi = 90°$;

(j) repeating the above-described steps (c) to (f); and

(k) determining a stress σ_{11} in a direction of the coordinate axis P1, a stress σ_{22} in a direction of the coordinate axis P2 and a shearing stress σ_{12} between the

coordinate axes P1 and P2 based on the strain ε (ϕ = 0°) determined in the above-described step (f), the strain ε (ϕ = 45°) determined in the above-described step (h), the strain ε (ϕ = 90°) determined in the above-described step (j) and $\sin^2\psi$ through the use of stress calculation formulae determined under the conditions of a plane stress state and a symmetry 4/mmm.

2. A stress measurement method using X-ray diffraction, comprising the steps of:

(a) preparing a c-axis-oriented specimen of a tetragonal polycrystal as a specimen to be measured;

(b) defining, as a specimen coordinate system, a coordinate axis P3 perpendicular to a surface of the specimen and two coordinate axes P1 and P2 orthogonal to each other within the specimen surface, and arranging an X-ray optical system including an X-ray source and an X-ray detector within an arbitrary plane including the coordinate axis P3;

(c) selecting one set of Miller indices (hkl) of the specimen, and arranging the X-ray source and the X-ray detector to be symmetrical with a normal to a crystal plane with said one set of Miller indices (hkl), the normal to the crystal plane being inclined from a normal to the specimen surface at an angle of ψ, so that a diffracted X-ray from

the crystal plane with said one set of Miller indices (hkl) can be detected with a diffraction angle θ_0 (diffraction angle in a non-strain state);

(d) irradiating the specimen with an X-ray, detecting the diffracted X-ray therefrom with the X-ray detector, adjusting the X-ray optical system to find out the diffraction angle θ at which the diffracted X-ray exhibits a maximum intensity, and determining the diffraction angle θ as a measurement value;

(e) determining a strain through the use of the diffraction angle θ_0 in the non-strain state and the diffraction angle θ measured;

(f) selecting another set of Miller indices (hkl) of the specimen, repeating the above-described steps (c) to (e), and determining a strain with respect to said another set of Miller indices (hkl);

(g) determining a plane stress σ within the specimen surface based on the strain ε determined in the above-described step (f) and $\sin^2\psi$ through the use of stress calculation formulae determined under the condition of an equi-biaxial stress state.